ORIGINAL RESEARCH ARTICLE

Disparities in the Wage-and-Salary Earnings, Determinants, and Distribution of Health Economics, Outcomes Research, and Market Access Professionals: An Exploratory Study

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Abstract

Objective The aim was to estimate the wage-and-salary earnings of a sample of health economics, outcomes research, and market access (HE/OR/MA) professionals; compare male versus female and US versus non-US earnings; assess the magnitude of the effect of several human-capital and job-related covariates on the determination of earnings; and examine inequality in the distribution of earnings.

Methods The study used self-reported survey data collected in 2017 from a subset of HE/OR/MA professionals in the HealthEconomics.com global subscriber list. HE/OR/MA professionals in this subset completed a questionnaire. The sample consisted of 372 participants who reported their wage-and-salary earnings and other indicators. The sample was not necessarily representative of the global HE/OR/MA community. The study methods included a two-way classification model with multiple replications, an ordinary least-squares model, and three inequality indicators.

Principal Findings The results suggested substantial disparities between the wage-and-salary earnings of respondents living in the USA and those living in other countries; mild gender disparities in earnings; greater inequality outside the USA than within the USA; and, within each location, more unequal distribution of men's earnings than that of women's earnings.

Conclusions Although the findings may not be extrapolated to the worldwide population of HE/OR/MA professionals, they provide a point of comparison with earlier studies and offer insights into the mechanics of one of the most innovative and fastest growing health-sector workforce segments in developed as well as emerging countries.

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Key Points for Decision Makers

There appear to be disparities between the earnings of health economics, outcomes research, and market access professionals living in the USA compared to other countries; within each location, there are mild gender disparities.

There also appears to be greater earnings inequality outside the USA than within the USA.

Within each location, there may be more unequal distribution of men's earnings compared to women's earnings.

1 Introduction

The health economics, outcomes research, and market access (HE/OR/MA) workforce provides economic reasoning for effective societal diffusion of discovery and innovation. Working closely with other healthcare professionals, as well as with social and behavioral scientists, it has played a crucial role in the translation of science and knowledge into sound health policies and outcomes. The current coronavirus disease 2019 (COVID-19) global pandemic has underscored the cross-functional nature and fundamental work of health economics and outcomes research (HE/OR) in addressing the negative effects of the pandemic in a timely manner [1–3].

Despite being one of the fastest growing and most innovative segments of the health-sector workforce across continents [4–9], HE/OR/MA professionals seldom are viewed as a cohesive group of workers bound by homogeneous work settings, complementary tasks, and congruous goals. Perhaps the apparent fragmentation has its roots in the fact that HE/OR/MA professionals are commonly found in a wide variety of institutions—private sector, government, and academia—with different expectations [10], which hinders the development of a stronger identity.

The specific focus of this paper is wage-and-salary earnings. Several studies indicate that pay is one of the most significant determinants of employees' motivation, attitudes, and behavior, especially pertaining to career choice, performance, and retention of worthwhile workers [11–13]; this is particularly relevant in light of the diffusion of these workers across health-sector institutions. Yet only four studies published within the last 30 years have addressed formally the earnings of HE/OR/MA professionals: Feldman and Morrisey [14] conducted a survey of health economists in 1989; Cawley and Morrisey [15] followed up with another survey of health economists in 2005; Carvajal et al. [16] broadened the analytical scope to include outcomes research and market access professionals in a survey conducted in 2015; and Ghosh et al. [17] identified variables associated with higher salaries.

This study sought to accomplish four purposes regarding HE/OR/MA professionals: (1) estimate their wage-and-salary earnings; (2) compare simultaneously male versus female and US versus non-US earnings levels; (3) assess the magnitude and importance of the effect of several human-capital and job-related covariates as determinants of earnings by gender and location; and (4) examine inequality in earnings distribution, also within gender and location.

2 Methods

This study was based on deidentified data voluntarily self-reported during the period January–March 2017 by HE/OR/MA professionals who subscribed to HealthEconomics.com, which is a comprehensive network that serves as a worldwide link to the health economics, outcomes research, and pharma market access stakeholder communities; its purpose is to connect people with resources, ongoing research, and employment and educational opportunities. Every subscriber, about 25,000 of them, was invited to participate in the survey. Respondents were asked to disclose the annual wage-and-salary earnings received from their professional work, country where they worked, gender, age, highest academic degree attained, amount of work experience as an HE/OR/MA professional, whether they worked full time or part time, type of work performed, primary job level, and employer's main area of operations.

Annual wage-and-salary earnings, not including bonuses or commissions, were reported in US dollars; adjustments in purchasing power by location were not made. Age was reported in years. The categories for highest academic degree attained were baccalaureate (BA and BS), master's (MA, MS, MBA, and MPH), doctoral (PhD, MD, and PharmD), and other. The categories for type of work performed were HE/OR (including patient-reported outcomes and health-related quality of life), market value or market access (including medical affairs, pricing, reimbursement, marketing, and advertising), technical operations (including medical writing, communications, biostatistics, epidemiology, information technology, and database analysis), academia, and other.

The categories for primary job level were top executive (chief executive officers, presidents, and vice-presidents), director (including chief and senior officers), associate or assistant director, manager, analyst (including specialists and research assistants), faculty member, and other. The categories for employer's main area of operations were pharmaceutical or biotechnology firm, contract research or consulting organization, academia, medical device firm, managed care (including insurance and pharmacy benefit) organization, and other (including healthcare providers and government, health technology assessment, and marketing/communications/advertising agencies).

2.1 Earnings Levels and Related Variables

A two-way classification model with multiple replications was designed to identify differences in earnings of the HE/OR/MA professionals in the 2017 survey. One classification consisted of both genders ($i = 1, 2$); the other classification distinguished between professionals living in and outside the USA ($j = 1, 2$). The "living outside the USA" classification grouped observations from nations all over the world whose only commonality was that the respondents did not work on US soil. Although wide variations in some key variables were expected within this group, the paucity of

observations in each country did not allow any other type of aggregation. Previous studies have shown that the gender earnings gap is greater in the liberal economies of English-speaking countries, particularly the USA, than in the corporatist economies of Continental Europe [16].

Within each gender–location cell, n_{ij} replications were observed. The model posed the advantage of allowing both gender and location differences to be tested simultaneously and independently of each other, plus testing for a possible gender–location interaction effect. This design has been applied successfully in the analysis of variations in earnings and other variables in the pharmacist workforce [18] as well as earnings of HE/OR/MA professionals [16].

The linear additive model was as follows:

$$Y_{ijk} = \mu + \gamma_i + \lambda_j + (\gamma\lambda)_{ij} + \varepsilon_{ijk}$$

where Y_{ijk} was the annual wage-and-salary earnings reported by the kth professional of the ith gender and the jth location; μ was the overall mean; γ_i was the systematic effect of the ith gender; λ_j was the systematic effect of the jth location; $(\gamma\lambda)_{ij}$ was the gender–location interaction effect; ε_{ijk} was the stochastic disturbance (random error) term of the kth professional of the ith gender and the jth location; and $i = 1$ for men and $i = 2$ for women; $j = 1$ for professionals living in the USA and $j = 2$ for professionals living outside the USA; and n_{ij} was the number of professionals of the ith gender and the jth location reporting their annual earnings.

The cutoff level for identifying statistical significance was established at $p = 0.10$.

2.2 Earnings Determinants

Within each gender–location cell, an earnings determination model was formulated and tested using ordinary least squares to estimate gender and location disparities in the effect, if any, of several human-capital and job-related covariates on the earnings of HE/OR/MA professionals. Separate functions with identical covariates were estimated for the four cells to compare the direction, magnitude, and statistical significance of the coefficients. An alternative pooled model, in which the gender and/or location effect would be identified by dichotomous variables, was dismissed because of its likely incorrect assumption that the earnings responses to covariates were equal for all respondents regardless of gender and/or location [19, 20]. Disparities in response, if they existed, were the kind of empirical evidence pursued by this article.

The annual wage-and-salary earnings of HE/OR/MA professionals in the sample were hypothesized to be a function of age, highest academic degree attained, type of work performed, primary job level, and employer's main area of operations, as follows:

$$\ln Y_{ijk} = \alpha_{ij} + \beta_{1ij}X_{ijk} + \beta_{2ij}X_{ijk}^2 + \delta_{ij}D_{ijk} + \tau_{ij}T_{ijk} + \varphi_{ij}J_{ijk} + \omega_{ij}E_{ijk} + u_{ijk}$$

where $\ln Y_{ijk}$ was the natural logarithm value of annual wage-and-salary earnings reported by the kth professional of the ith gender and the jth location. X_{ijk} was the age reported by the kth professional of the ith gender and the jth location. D_{ijk} was a dichotomous variable measuring the highest academic degree reportedly attained by the kth professional of the ith gender and the jth location (it was assigned a value of 1 if the kth professional reported having earned a doctoral degree, and a value of 0 otherwise). T_{ijk} was a dichotomous variable measuring the type of work performed by the kth professional of the ith gender and the jth location (it was assigned a value of 1 if the kth professional reported working as a health economics or outcomes research specialist, and a value of 0 otherwise). J_{ijk} was a dichotomous variable measuring the primary job level reported by the kth professional of the ith gender and the jth location (it was assigned a value of 1 if the kth professional reported being a top executive or director, and a value of 0 otherwise). E_{ijk} was a dichotomous variable measuring the employer's main area of operations reported by the kth professional of the ith gender and the jth location (it was assigned a value of 1 if the kth professional reported working in a pharmaceutical or biotechnology firm, and a value of 0 otherwise). α_{ij} was the least-squares constant term estimated for the ith gender and the jth location equation. β_{1ij} and β_{2ij} were the least-squares coefficients of the linear and quadratic terms, respectively, estimated for age in the ith gender and the jth location equation. δ_{ij}, τ_{ij}, φ_{ij}, and ω_{ij} were the least-squares coefficients estimated for the dichotomous variables in the ith gender and the jth location equation. u_{ijk} was the stochastic disturbance (random error) term of the kth professional of the ith gender and the jth location, which was expected to be drawn from a normal, independent distribution with mean zero and variance σ_{ij}^2. $i = 1$ for men and $i = 2$ for women. $j = 1$ for professionals living in the USA and $j = 2$ for professionals living outside the USA. n_{ij} was the number of professionals in the ith gender and the jth location equation.

HE/OR/MA professionals' earnings levels were logged to reduce the impact of outliers and allow interpretation of relative rather than absolute differences [21, 22]. The estimated least-squares coefficients in this semilog earnings determination model denoted exponential values. An addition of 0.693147 to the natural logarithm value of a number doubles the value of the number; conversely, a subtraction of 0.693147 from the natural logarithm value of a number cuts the value of the number by one-half.

The model included two human-capital covariates and three job-related covariates. For nominal variables in the dataset, only one category was identified in the equation to avoid multicollinearity and conserve degrees of freedom. The human-capital covariates were age as a proxy for work

experience and educational attainment. Age, measured in years, had linear and quadratic components to measure direction and rate of change. Anticipating that more experience would lead to greater productivity and earnings up to a point beyond which obsolescence would begin to set in, the linear term was hypothesized to be positive and the quadratic term was hypothesized to be negative. Educational attainment, measured as a dichotomous variable for professionals with doctoral degrees, was hypothesized to have a positive coefficient denoting higher earnings levels than those of their peers without a doctoral degree.

The other covariates identified here focused on job-related characteristics. They included working as a health economist or outcomes research specialist, being a top executive or director, and working in a pharmaceutical or biotechnology firm. All three were dichotomous covariates whose effect on earnings was expected to be positive. HE/OR specialists were anticipated to earn relatively higher wages and salaries than professionals in other types of work because of their leadership role and specialized training [15], top executives and directors were expected to rank at the top of the income scale in their institutions, and workers in biopharmaceutical firms were foreseen to be well paid due to the fast growth pace of the market [23].

2.3 Earnings Inequality

Inequality in the distribution of wage-and-salary earnings within each gender–location cell was estimated using three measures of dispersion: the lower median share, the 90–10 decile ratio, and the Gini coefficient. These were the three indicators used by Carvajal et al. [16] in the analysis of a similar data set gathered in 2015. The indicators focused on different aspects of inequality, each measuring a perspective of earnings disparity that might be bypassed by the others. It is not uncommon for analysts to estimate several indicators in search of a more comprehensive view of a particular earnings distribution [24–26].

The lower median share measured the percentage of total earnings reported by the lower half of HE/OR/MA professionals in the sample, arranged in descending order. Its advantages are ease of calculation and portrayal of earnings split down the middle of the distribution; its main disadvantage is the inability to provide an insight into the nature of the spread within either half of earners [27]. Lower values of this indicator are indicative of greater inequality.

The 90–10 decile ratio measured the aggregate earnings reported by participants in the top 10% of the distribution divided by the aggregate earnings of the bottom 10%. It focuses solely on earnings reported at both ends of the array without considering the 80% of earners in the middle. Greater inequality is portrayed by higher values of this indicator [28].

The Gini coefficient is the most frequently used measure of inequality [29–31], but it is difficult to compute. Here, it was obtained by averaging the differences between all possible pairs of earnings levels in the data set [32]. The Gini coefficient is more sensitive to changes in the middle of the distribution than to changes at either end; one of its disadvantages is that it is not able to identify different kinds of inequality [33]. Higher values of this indicator denote greater inequality.

3 Results

A total of 372 HE/OR/MA professionals participated in the study by providing answers to all relevant questions. This represented approximately 1.5% of HealthEconomics. com subscribers. The number of respondents was slightly smaller than the one reported for the previous HE/OR/MA professionals' income study, but it compared favorably with those reported by similar undertakings [34–36] and it allowed enough degrees of freedom for meaningful statistical inferences. Of the 372 participants, 195 were men (52.4%) and 177 were women (47.6%), and 232 lived in the USA (62.4%), while 140 lived outside the USA (37.6%). The male–female breakdown was similar for both locations. The distribution was similar to the distribution of the approximately 25,000 subscribers to HealthEconomics.com (49.2% men and 50.8% women, 56.0% living in the USA and 44.0% living outside the USA). The country composition of the 140 respondents living outside the USA was as follows: 23 were from the UK (16.4%), 16 were from Switzerland (11.4%), 48 were from the rest of Europe (34.3%), 19 were from India (13.6%), 11 were from Canada (7.9%), and the additional 23 respondents were from other parts of the world (16.4%).

3.1 Earnings Levels and Related Variables

The estimated mean and standard deviation values of wages and salaries by gender and location reportedly earned by the HE/OR/MA professionals in the sample are presented in Table 1. Within each location, men earned higher wages and salaries than women, and within each gender, respondents living in the USA earned higher wages and salaries than those living outside the USA. Both gender and location differences were statistically significant, but no significant interaction effect was detected. The US wage-and-salary figures were higher than the ones reported in the 2015 survey, particularly for women, but for both male and female participants living outside the USA, reported wages and salaries in 2017 declined considerably vis-a-vis those reported 2 years prior. The earnings drop of non-US professionals was greater than the earnings gain of their US counterparts,

Table 1 Number of observations in the sample and estimated values of the mean and standard deviation of HE/OR/MA professionals' annual wage-and-salary earnings (in US dollars) by gender and location, 2017

Location	Indicator	Gender		
		Men ($i=1$)	Women ($i=2$)	Both genders
US ($j=1$)	Number of observations	120	112	232
	Mean ($)	181,917	163,415	172,985
	Standard deviation ($)	108,725	66,521	91,114
Non-US ($j=2$)	Number of observations	75	65	140
	Mean ($)	103,900	91,885	98,321
	Standard deviation ($)	73,037	55,534	65,544
Both locations	Number of observations	195	177	372
	Mean ($)	151,910	137,147	144,886
	Standard deviation ($)	103,604	71,470	89,947

Mean income differences between genders: $F = 2.99$ ($p = 0.084$)

Mean income differences between locations: $F = 71.88$ ($p \leq 0.001$)

Gender–location interaction effect: $F = 0.14$ (not statistically significant)

so the overall 2017 reported wages and salaries were 1.7% less than in 2015.

The empirical evidence from the sample revealed that compared to US men's average wages and salaries, US women earned 89.8% (earnings gap of 10.2%), non-US men earned 57.1% (earnings gap of 42.9%), and non-US women earned 50.5% (earnings gap of 49.5%). These estimates did not take into account purchasing power parity and were unadjusted for possible determinants. They might have been influenced by differences in the number of hours worked, human-capital characteristics, job-related characteristics, and/or employer's preferences, as well as by inter-country variations in macroeconomic variables such as economic growth, unemployment, and tax structure, to name a few.

Respondents' estimated values of selected variables commonly hypothesized to explain disparities in wages and salaries are presented in Table 2. The results indicated that men and women in each location reported approximately the same age, but HE/OR/MA professionals living in the USA were older than those not living in the USA. Within each location, men and women exhibited approximately the same percentage of doctoral degrees, but participants living in the USA reported attaining a higher percentage of doctoral degrees than participants living outside the USA.

In terms of job-related characteristics, proportionately more women than men in each location, and more US than non-US respondents, reported working part time, although for all practical purposes, virtually all respondents of both genders and both locations worked full time. The percentages of professionals who reported their job function as HE/OR specialists were similar for both genders, but greater for US residents than for respondents living outside the USA. The percentage composition of primary-job level showed more male than female respondents holding a top executive or director position in their place of employment; within gender, the proportion of participants who were top

executives or directors was greater for US than for non-US residents. Finally, in terms of employer's main area of operations, the relative gender–location concentration was the opposite of the one portrayed by earnings: within each location, the percentage of HE/OR/MA professionals in the sample working in pharmaceutical or biotechnology firms was lower for men than for women, and within each gender, it was lower in the USA than outside the USA.

3.2 Earnings Determinants

The estimated least-squares coefficients, standard errors, and levels of significance of the covariates of the earnings determination model are presented in Table 3. The coefficient values of all covariates were statistically significant for at least one gender–location group, and most coefficient values were significant for both genders and both location groups. All four F ratios were significant, and the adjusted R^2 values suggested that between one-half and two-thirds of the variation in the natural logarithm values of earnings was explained by the covariates in the model.

The age least-squares coefficients behaved as expected—positive linear terms and negative quadratic terms, all statistically significant. According to these estimates for HE/OR/MA professionals in the sample, on average, an additional year of age yielded an 11.8% increase in the earnings of US men, a 6.0% increase in the earnings of US women, a 9.3% increase in the earnings of non-US men, and a 14.9% increase in the earnings of non-US women. Attainment of a doctoral degree, the other human-capital covariate, was significant only for US women, whose earnings were, on average, 25.0% higher than those of women without doctoral degrees living in the USA.

Working as an HE/OR specialist was significant for practitioners living outside the USA, but not for US practitioners; compared to their counterparts of the same gender living

outside the USA who did not work as HE/OR specialists, male HE/OR specialists in the sample earned 33.6% less, but female HE/OR specialists earned 27.9% higher wages and salaries. Being a top executive or director was significant in all four gender–location categories. Compared to respondents of the same gender and location who were not top executives or directors, US men reported 63.4% higher earnings, US women reported 53.1% higher earnings, non-US men reported 82.9% higher earnings, and non-US women reported 85.3% higher earnings. Working in a pharmaceutical or biotechnology firm also was statistically significant across the board; compared to their peers of the same gender and location who worked in other areas of operations, these HE/OR/MA professionals earned 30.0% more if they were

men living in the USA, 27.1% more if they were women living in the USA, 46.0% more if they were men living outside the USA, and 49.9% more if they were women living outside the USA.

3.3 Earnings Inequality

The estimated values of participants' lower median shares, 90–10 decile ratios, and Gini coefficients are presented in Table 4. Lower median share values were similar for men and women within each location, but they were lower for HE/OR/MA professionals living outside the USA, thus suggesting greater inequality in the distribution of wages and salaries than for HE/OR/MA professionals living in the USA. In other

Table 2 Estimated sample values of variables hypothesized to influence HE/OR/MA professionals' annual wage-and-salary earnings by gender and location, 2017

Variable	Location	Variable categories	Gender		
			Men ($i=1$)	Women ($i=2$)	Both genders
Age (years), mean (standard deviation)	US ($j=1$)		42.9 (10.6)	41.9 (10.3)	42.4 (10.4)
	Non-US ($j=2$)		39.7 (10.6)	39.2 (9.2)	39.4 (9.9)
	Both locations		41.6 (10.7)	40.9 (9.9)	41.3 (10.3)
Highest academic degree attained (%)	US ($j=1$)	Baccalaureate	11.0	8.1	9.6
		Master's	39.0	40.5	39.8
		Doctoral	50.0	50.5	50.2
		Other	–	0.9	0.4
	Non-US ($j=2$)	Baccalaureate	6.9	14.3	10.4
		Master's	51.4	50.8	51.0
		Doctoral	38.9	33.3	36.4
		Other	2.8	1.6	2.2
	Both locations	Baccalaureate	9.5	10.3	9.9
		Master's	43.7	44.2	44.0
		Doctoral	45.7	44.3	45.0
		Other	1.1	1.2	1.1
Employment status (%)	US ($j=1$)	Full time	98.3	93.7	96.1
		Part time	1.7	6.3	3.9
	Non-US ($j=2$)	Full time	100.0	98.5	99.3
		Part time	–	1.5	0.7
	Both locations	Full time	99.0	95.4	97.3
		Part time	1.0	4.6	2.7
Type of work (%)	US ($j=1$)	Health economics and outcomes research	46.7	43.7	45.3
		Market value or market access	36.6	30.4	33.6
		Technical operations	10.0	17.8	13.8
		Academia	4.2	4.5	4.3
		Other	2.5	3.6	3.0
	Non-US ($j=2$)	Health economics and outcomes research	36.0	40.0	37.9
		Market value or market access	52.0	44.6	48.6
		Technical operations	6.7	7.7	7.1
		Academia	1.3	3.1	2.1
		Other	4.0	4.6	4.3
	Both locations	Health economics and outcomes research	42.6	42.3	42.5
		Market value or market access	42.6	35.6	39.2
		Technical operations	8.6	14.1	11.3
		Academia	3.1	4.0	3.5
		Other	3.1	4.0	3.5

Table 2 (continued)

Variable	Location	Variable categories	Gender		
			Men ($i=1$)	Women ($i=2$)	Both genders
Primary job level (%)	US ($j=1$)	Top executive	25.0	16.0	20.7
		Director	33.3	29.5	31.5
		Associate or assistant director	8.3	15.2	11.6
		Manager	11.7	15.2	13.4
		Analyst	8.3	8.0	8.2
		Faculty member	5.0	2.7	3.9
		Other	8.4	13.4	10.7
	Non-US ($j=2$)	Top executive	14.7	4.6	10.0
		Director	33.3	24.6	29.3
		Associate or assistant director	4.0	9.3	6.4
		Manager	28.0	33.8	30.7
		Analyst	16.0	20.0	17.9
		Faculty member	1.3	1.5	1.4
		Other	2.7	6.2	4.3
	Both locations	Top executive	21.0	11.9	16.6
		Director	33.3	27.7	30.6
		Associate or assistant director	6.7	13.0	9.7
		Manager	17.9	22.0	19.9
		Analyst	11.3	12.4	11.8
		Faculty member	3.6	2.3	3.0
		Other	6.2	10.7	8.4
Employer's main area of operations (%)	US ($j=1$)	Pharmaceutical or biotechnology	40.0	44.6	42.2
		Contract research or consulting	27.5	24.1	25.9
		Academia	5.8	5.4	5.6
		Medical device	10.8	8.0	9.5
		Managed care	10.0	7.1	8.6
		Other	5.9	10.8	8.2
	Non-US ($j=2$)	Pharmaceutical or biotechnology	52.0	56.9	54.3
		Contract research or consulting	26.6	24.7	25.7
		Academia	1.3	3.1	2.1
		Medical device	5.3	7.7	6.4
		Managed care	1.3	-	0.7
		Other	13.5	7.6	10.8
	Both locations	Pharmaceutical or biotechnology	44.6	49.2	46.8
		Contract research or consulting	27.2	24.3	25.8
		Academia	4.1	4.5	4.3
		Medical device	8.7	7.9	8.3
		Managed care	6.7	4.5	5.7
		Other	8.7	9.6	9.1

HE/OR/MA health economics, outcomes research, and market access

words, the fraction of total earnings reported by the lower half of respondents (arranged in descending order) was higher for the USA than for all other countries taken globally.

A pattern of more inequality in the distribution of wages and salaries of HE/OR/MA professionals living outside than in the USA was also suggested by the relatively higher values of the estimated 90–10 decile ratios. In addition, the empirical evidence pointed toward greater disparity between the top and bottom deciles within the distribution of men's earnings than within the distribution of women's earnings in each location.

The estimated Gini coefficient values were higher for respondents living outside the USA than for US respondents, which reinforced the empirical pattern of inequality portrayed by the two other indicators: the distribution of HE/OR/MA professionals' earnings reported in the sample was more unequal outside the USA than in the USA. Although the male Gini coefficient values exceeded the female values in each location, the difference was rather mild and might be largely attributable to random variation.

Table 3 Estimated least-squares coefficients, their standard errors (in parentheses), and (two-tail) levels of significance of covariates in the model by gender and location, 2017

Variable	Term	Estimated least-squares coefficients, standard errors, and levels of significance			
		Living in the USA ($j=1$)		Living outside the USA ($j=2$)	
		Men ($i=1$)	Women ($i=2$)	Men ($i=1$)	Women ($i=2$)
Constant	α	8.9861	9.9857	8.8019	7.4529
Age (linear)	β_1	0.1134* (0.0241)	0.0590‡ (0.0259)	0.0907‡ (0.0393)	0.1422* (0.0476)
Age (quadratic)	β_2	− 0.0012* (0.0003)	− 0.0005† (0.0003)	− 0.0009† (0.0005)	− 0.0014‡ (0.0006)
Doctoral degree	δ	0.0324 (0.0786)	0.2228* (0.0673)	0.0540 (0.1145)	0.0418 (0.1273)
HE/OR specialist	τ	− 0.0395 (0.0784)	− 0.0296 (0.0668)	− 0.4090* (0.1300)	0.2458† (0.1372)
Top executive or director	φ	0.4907* (0.0830)	0.4260* (0.0699)	0.6036* (0.1322)	0.6169* (0.1382)
Pharmaceutical or bio-technology firm	ω	0.2624* (0.0745)	0.2401* (0.0656)	0.3787* (0.1139)	0.4049* (0.1306)
F statistic		19.03*	22.44*	24.63*	15.57*
Adjusted R^2		0.485	0.541	0.666	0.585

HE health economics, *OR* outcomes research

*Statistically significant ($p \leq 0.01$)

‡Statistically significant ($p \leq 0.05$)

†Statistically significant ($p \leq 0.10$)

Table 4 Estimated sample values of three measures of dispersion of HE/OR/MA professionals' annual wage-and-salary earnings by gender and location, 2017

Measure of dispersion	Location	Gender		
		Men	Women	Both genders
Lower median share	US	0.314	0.337	0.324
	Non-US	0.212	0.250	0.235
	Both locations	0.267	0.288	0.278
90–10 decile ratio	US	7.45	4.93	6.31
	Non-US	10.20	8.07	9.31
	Both locations	13.96	11.02	12.53
Gini coefficient	US	0.273	0.228	0.254
	Non-US	0.385	0.334	0.365
	Both locations	0.334	0.293	0.317

HE/OR/MA health economics, outcomes research, and market access

4 Discussion

The empirical evidence of this study points toward possibly substantial disparities between the observed wage-and-salary earnings of HE/OR/MA professionals living in the USA and those living in other countries. Unfortunately, data on the number of hours worked per participant were not available. The number of hours worked per week, month, etc. might have contributed to the portrayal of a more comprehensive view of earnings disparities. However, the results indicate that only a few of the HE/OR/MA professionals in the sample worked part time; therefore, earnings comparisons between genders and between locations seem to be appropriate.

When both genders were taken together, non-US participants reported an earnings gap of 43.2% with respect to their counterparts residing and working in the USA. Curiously, the location earnings gap was virtually the same for both men and women. Gender disparities in wages and salaries, regardless of location, were less notable, although they were statistically significant. This did not accord with the findings of Ghosh et al. [17]; perhaps the statistical significance between genders found here may be explained by the disaggregation of observations between those living in and outside the USA. When the earnings of respondents from all locations were grouped solely by gender, the female gap was 9.7%, lower than the gap reported by Carvajal et al. [16]. The female earnings gap also was very similar for US and non-US HE/OR/MA professionals in the sample.

Along with the increase in US earnings and decline in non-US earnings observed from 2015 to 2017 (US earnings increased by 5%, while non-US earnings decreased by 14%), the participants' gender and location distribution of age in both surveys remained approximately the same; the percentage of both genders who attained a doctoral degree decreased in the USA, but increased outside the USA and, within each gender, the small fraction of part-time work increased in the USA, but decreased outside the USA. Compared to the results of the 2015 sample, the proportion of HE/OR/MA professionals in the 2017 sample who reported their job function as HE/OR specialists declined in all categories except women living outside the USA; the percentage who reported holding a top executive or director position remained the same in the USA, but outside the USA it went up for men and down for women; and the proportion of

respondents working in a pharmaceutical or biotechnology firm went down for all categories except US men.

Since location disparities, and to a lesser extent gender disparities, in participants' wage-and-salary earnings might have been influenced by inter-country variations in macroeconomic variables, a review of the estimated values of the effect of human-capital and job-related covariates as earnings determinants in the model seemed relevant. Unfortunately, the empirical evidence of the human-capital covariates was mixed and inconclusive. Older age, a proxy for greater professional experience, appeared to increase in the USA the earnings of men more than the earnings of women, while outside the US, women benefitted more from experience than did men; furthermore, in terms of earnings, US men benefitted more from experience than non-US men, while non-US women seemed to benefit more from experience than US women. The other human-capital covariate, attainment of a doctoral degree, lacked statistical significance for three of the four gender–location groupings, so no comparisons could be made. The higher wages and salaries earned by US women with doctoral degrees, relative to US women without doctoral degrees, accorded with the findings by Cawley and Morrisey [15]. The findings here seemed to suggest that attaining a doctoral degree might be a wage-and-salary equalizer for female HE/OR/MA professionals in the USA.

The behavior of the job-related covariates was more consistent. The estimated male and female coefficients of non-US respondents who identified themselves as HE/OR specialists possessed statistical significance, whereas the coefficients of US HE/OR specialists did not. The effect, however, was different for men and women. Contrary to expectations, male HE/OR specialists in the sample living outside the USA earned lower wages and salaries than their counterparts working in other job functions, while for women the opposite was the case—female HE/OR specialists living outside the USA reported higher earnings than those in other types of work.

Both men and women living outside the USA who reported their primary job level as top executive or director benefitted relatively more from their position vis-a-vis those of the same gender who were neither top executives nor directors than did their US counterparts. (The positive sign of the estimated coefficients conformed to expectations.) Part of this differential may be related to the greater gender percentage of HE/OR/MA professionals in the sample observed working at these job levels in the USA than outside the USA. Along the same lines, however, within each location, the fraction of male top executives and directors exceeded substantially the fraction of women; yet the values of the least-squares coefficients for both genders were analogous.

A similar trend was observed with the covariate measuring employer's main area of operations. Both non-US men

and women who reported working in a pharmaceutical or biotechnology firm earned relatively higher wages and salaries compared to those working for other types of employers than did their counterparts of the same gender living in the USA. But in this case, the percentage of non-US participants working in pharmaceutical or biotechnology firms was greater than the percentage of US participants. In all equations, the overall F ratio values were statistically significant and the adjusted R^2 values indicated that the covariates specified in the model provided a good fit for both men and women as well as for US and non-US residents.

In terms of disparities in the distribution of reported earnings, all three indicators pointed toward greater inequality outside the USA than within the USA, which was consistent with the findings of Carvajal et al. [16]. Inter-country variations in price levels, exchange rates, tax systems, and other macroeconomic variables probably influenced the greater disparity. Within each location, the distribution of men's wages and salaries was found to be consistently more unequal than the distribution of women's wages and salaries, even though relatively more women than men reported working part time. This finding accorded with those of Carvajal et al. [32] and Dale-Olsen and Østbakken [37], and probably reflected greater competitiveness within men than within women. When compared with the results of the 2015 survey, the evidence here also pointed towards an increase in earnings inequality over the 2-year period. For most gender–location classifications, the lower median share values went down, the 90–10 decile ratio values went up, and the Gini coefficient values went down.

4.1 Limitations

Several limitations may be identified throughout this paper that make the findings exploratory in nature. The most severe limitation was gathering the information from a convenience sample. The number of observations was relatively small. Although the sample exhibited similar gender and location compositions to the population from which it was drawn, respondents' socioeconomic characteristics and earnings patterns might have differed from those of HE/OR/MA professionals who were not subscribers to HealthEconomics.com or, while being subscribers, did not participate in the survey. Thus, the results reported here cannot be extrapolated to the global HE/OR/MA community.

The study relied on cross-sectional data, which were inadequate to address changes over time in the values and distribution of wages and salaries. The values of wage-and-salary earnings, reported in US dollars by participants, were not adjusted for purchasing power, tax structures, or other internal market conditions in each country; this limitation affected not only variation of earnings outside the USA, but it also affected variation within the USA, as different parts

of the country experienced differences in prices and taxes. The net effect probably was an upward bias in the estimated indicators of inequality, affecting the distribution of earnings outside the USA to a greater extent than within the USA, as the effect of heterogeneous government networks, healthcare delivery systems, and institutional regulations was not taken into consideration.

Another limitation was reliance on self-reported wage-and-salary data not validated for accuracy with employers. Other data such as age, level of education, type of work performed, primary job level, and employer's main area of operations were not validated either. Furthermore, since all participants in the sample were working, their responses were subject to a sample selection bias [36].

Still another limitation was the omission of some covariates measuring determinants of wages and salaries commonly identified in the literature. For example, data on the average number of hours worked per week or per month might have allowed the formulation of more precise earnings determination functions. Similarly, the addition of certain job-preference variables (i.e., commuting distance/time, availability of flexible work schedules, etc.) or job-satisfaction variables (i.e., job atmosphere, relations with peers and supervisors, etc.) might have allowed the measurement of compensating differentials and established the relative importance of wages and salaries vis-a-vis other work-related variables.

5 Conclusion

Despite its limitations, this study was successful in estimating the wage-and-salary earnings of a sample of HE/OR/MA professionals from multiple countries, comparing simultaneously male versus female and US versus non-US earnings levels, assessing the magnitude and importance of the effect of several human-capital and job-related covariates on wages and salaries by gender and location, and examining inequality in the distribution of earnings. It has provided a point of comparison with earlier studies and has shed light into the mechanics of one of the most innovative and fastest growing health-sector workforce segments in developed as well as emerging nations. Further work is needed to research the apparent trend toward greater earnings inequality, enlarge the segment of HE/OR/MA professionals under study, and broaden the scope of inquiry to include human-capital and job-related indicators beyond those explored here, as well as the institutional forces that contribute to the work of HE/OR/MA professionals in multiple and heterogeneous markets throughout the world. Such an endeavor is likely to present an opportunity to reduce the time needed to formulate research questions, increase the

quality of the answers, and expand and refine HE/OR/MA professionals' involvement in the rational analysis of the provision of healthcare services.

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